SERVICE TIMES, CAPACITY, AND OPERATING CHARACTERISTICS OF AUTOMATED LANES AT NATIONAL PARK ENTRANCE STATIONS

Prepared for the National Park Service

By

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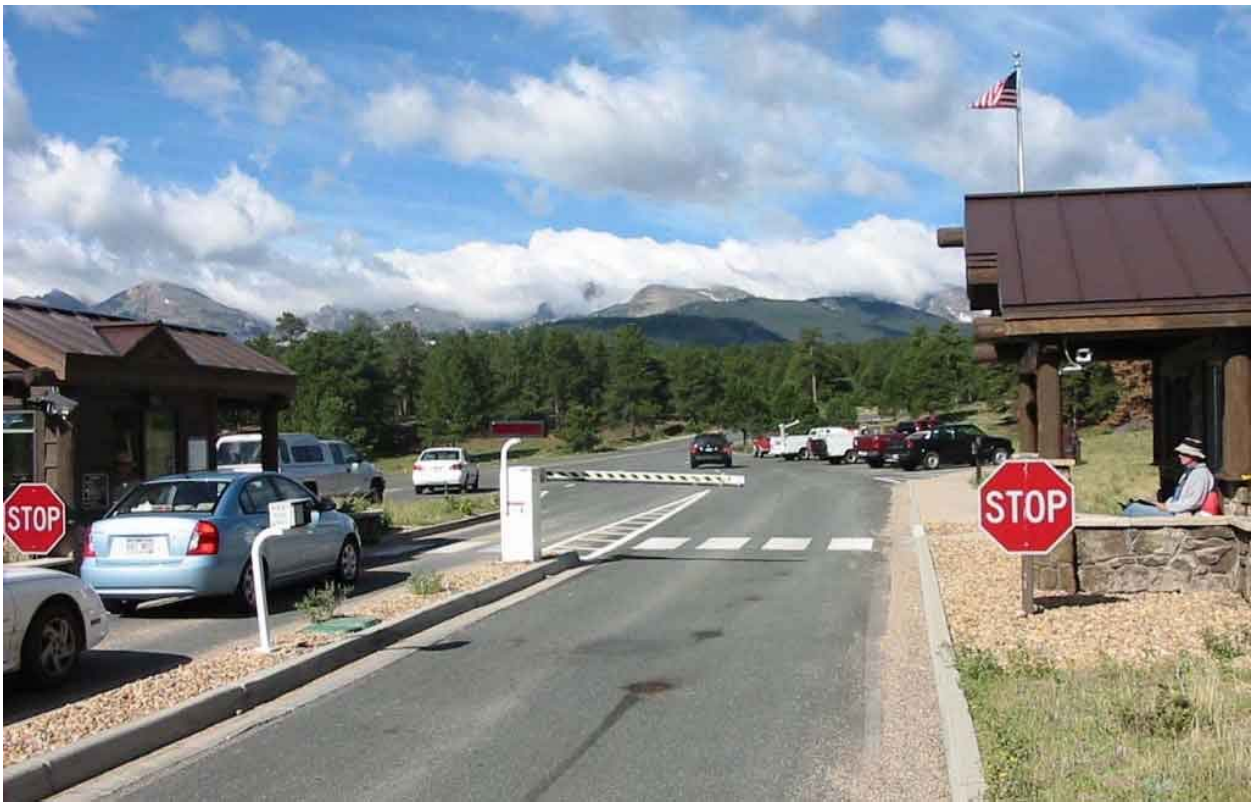


Rocky Mountain National Park – Beaver Meadows Entrance Station automated lane

INTRODUCTION

Parks that become interested in the possible use of an automated lane at their entrance station are usually interested in the answers to one or more of the following questions.

- Will an automated lane improve entrance station operation?
- Will an automated lane increase entrance station capacity?
- Will an automated lane facilitate entry, and reduce waiting time, for certain classes of users?
- Will an automated lane reduce personnel costs?
- What advantages and disadvantages are associated with an automated lane?

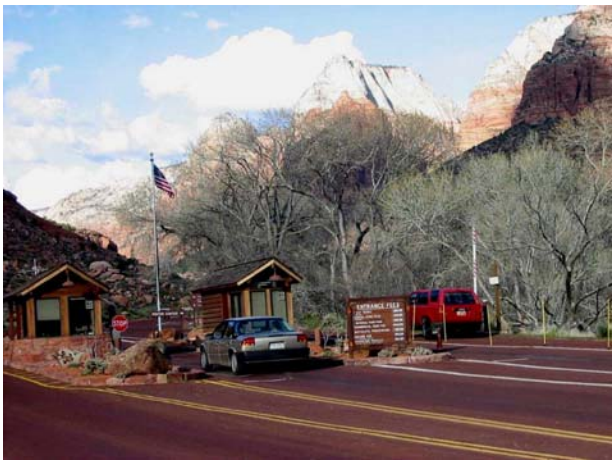
The answers to these questions are often not clear-cut and depend upon various conditions at the entrance station location. This report seeks to provide answers to the above questions and provide additional information that will be useful to Park staffs in evaluating the possible use of automated lanes.

AUTOMATED LANES - OVERVIEW

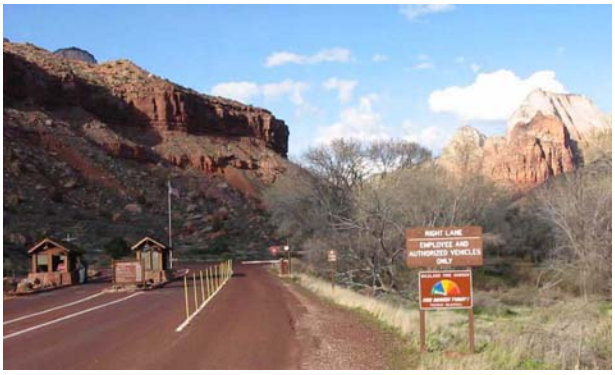
Five National Parks have implemented automated lanes at entrance stations. An automated system to process selected vehicles has the potential of reducing congestion and waiting times, reducing personnel costs, and providing expedited entry for certain users.

The following paragraphs provide a brief overview of the Parks that have installed automated lanes, the operation of automated lanes, the technologies that are used, and the classes of vehicles that are eligible to use automated lanes.

Assateague Island National Seashore and Bryce Canyon, Rocky Mountain, Yellowstone, and Zion National Parks have implemented automated lanes for vehicle entry at entrance stations. Table B-1 presents additional details on implementation at each Park.



Zion Entrance Station – Red SUV in Automated Lane (right hand lane)



Automated Lane at Zion (right hand lane)

TABLE B-1 - AUTOMATED LANES AT PARK ENTRANCE STATIONS

PARK UNIT	LOCATION	TECHNOLOGY	ELIGIBLE USERS	NUMBER OF ELECTRONIC TAGS OR MAGNETIC CARDS DISTRIBUTED	CONTACT PERSON
IN OPERATION					
Assateague Island National Seashore	Maryland Entrance	Magnetic Card Reader	Holders of Assateague Island Annual Park Pass	Approximately 10,500 Annual Passes sold in 2005	Debbie Morlock 710-629-1091
Bryce Canyon National Park		Transponder / Electronic Tag	Selected employees, permanent Park residents, Park ambulance, transit vehicles	113 electronic tags issued	Dan Cloud 435-834-4200
Rocky Mountain National Park	Beaver Meadows Entrance	Magnetic Card Reader	Holders of Rocky Mountain National Park Annual Pass plus other selected passholders	Sales in CY 2005: 31,159 Rocky Mtn NP Annual Passes 25,119 National Parks Passes 14,357 Golden Age Passports 2 to 12 passes sold elsewhere are re-encoded each day 169,606 automated entries in 2005	John Hannon 970-586-1365
		Transponder / Electronic Tag	Employees, Park residents, concessionaire vehicles	Approximately 250 electronic tags issued.	
Yellowstone National Park	North Entrance	Transponder / Electronic Tag	Employees, Park residents, and about 50 concessionaire vehicles	Approximately 600 electronic tags issued	Tammy Wert 307-344-2115
Zion National Park	South Entrance	Transponder / Electronic Tag	NPS employed Park residents, selected concessionaire vehicles, selected vendor vehicles	Approximately 550 electronic tags issued. Usage averages about 120 openings per day.	Shelagh Forester 435-772-7816
PLANNED					
Gulf Islands National Seashore	Fort Pickens				Sally Lewis 850-934-2620
Yellowstone National Park	West Entrance	Transponder / Electronic Tag, Proximity Card			Tammy Wert 307-344-2115
PROGRAMMED					
Rocky Mountain National Park	Fall River Entrance Grand Lake Entrance				John Hannon 970-586-1365

Processing of vehicles in an automated lane can be accomplished by multiple technologies. A transponder-based system uses a roadside antenna to "read" an electronic tag on the vehicle. This is referred to as Automatic Vehicle Identification (AVI) and is the technology used by toll roads for electronic toll collection. A vehicle simply approaches the entry area and roadside antenna. The electronic tag is "read" and the system grants entry to the eligible vehicle. Because of the high cost of the electronic tag, this technology is not practical for the typical tourist visitor. It does, however, have application for repeat users such as employees, Park residents, Park Service vehicles, commercial vendors who provide services in the Park, concessionaire vehicles, transit or shuttle service, and others. The electronic tag technology is used at Bryce Canyon, Rocky Mountain, Yellowstone and Zion.

A second technology reads a magnetic strip such as exists on a credit card. The same type of magnetic strip exists on National Parks Passes, Golden Age Passports, and Golden Access Passports. Swiping the Pass in a card reader allows the system to identify an eligible user and

provide access to the Park. Magnetic card reader technology is used at Assateague Island National Seashore and at Rocky Mountain's Beaver Meadows entrance station (photos below). Holders of the Assateague Island annual pass or the Rocky Mountain National Park annual pass, respectively, swipe their pass through a magnetic card reader, similar to those used for credit card purchases**.** The system then allows access to the Park.

Photo Credit: Roger Surdahl, FHWA-CFLHD

Automated Gate at Beaver Meadows

Photo Credit: Roger Surdahl, FHWA-CFLHD

Magnetic Card Reader at Beaver Meadows

With either the transponder technology or the magnetic card reader technology, the system can allow access by either opening a gate arm or by changing a traffic signal indication from red to green. Yellowstone's system uses a traffic signal indication and the four other Parks use gate arms.

A third technology is being considered for a new entrance station at the West Entrance to Yellowstone. Yellowstone Park employees have ID cards that function as proximity cards providing keyless entry to locked buildings and doors. The ID card is waved in front of a reader that identifies the employee as eligible for entry to the building or room. Yellowstone plans to use the employees' proximity ID cards in the same manner for entry to the Park in an automated lane.

As shown in Table B-1, the eligible users vary from Park to Park. Bryce Canyon, Zion and Yellowstone have elected to make their automated lanes available only to small numbers of frequent users, such as employees and Park residents. On the other hand, Assateague Island and Rocky Mountain allow select groups of visitors to use their automated lanes (see description, below, of Rocky Mountain eligible visitor users). As a result, the amount of usage of the automated lanes is substantially higher at Assateague Island and Rocky Mountain. Table B-1 presents the number of electronic tags issued and number of magnetic cards sold in each Park.

For the magnetic card reader technology, the system needs to know whether a card is valid or has expired. The annual pass for Assateague Island National Seashore is a calendar year pass and the expiration date is known and is magnetically encoded on these passes prior to sale. The annual pass for Rocky Mountain National Park is good for 12 months from the date of issue and, again, the expiration date is magnetically encoded on the card prior to sale. Because National Parks Passes and Golden Age Passports are not encoded with an expiration date, Rocky Mountain National Park, initially, did not allow these passes to be used in an automated lane. That restriction has now changed, and visitors who may use the automated lane are as follows.

1. Those who have purchased a Rocky Mountain National Park Annual Pass.
2. Those who purchased a National Parks Pass or a Golden Age Passport at Rocky Mountain National Park.
3. Those who purchased a National Parks Pass or a Golden Age Passport at another location, and who present the card at the Beaver Meadows Entrance Station for re-encoding.

Beaver Meadows has a magnetic strip encoder at the entrance station and can encode an expiration date on the card. The expiration date is encoded on new National Parks Passes and Golden Age Passports that are sold at the entrance station. The expiration date is encoded on National Parks Passes and Golden Age Passports purchased elsewhere, at the request of the visitor.

SERVICE TIMES AND CAPACITY OF AUTOMATED LANES

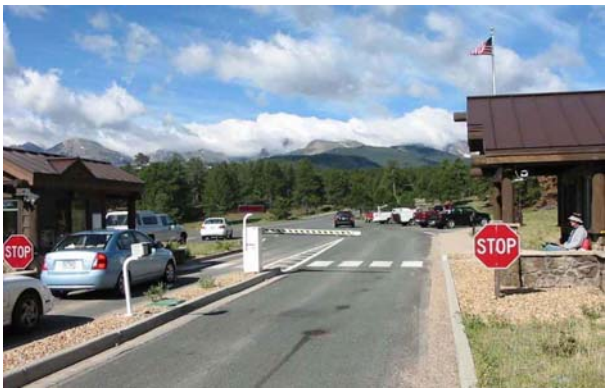
Most Parks that consider an automated lane are likely to be motivated by existing congestion, long queues, and long waiting times. These are conditions that usually reflect a demand (number of vehicles arriving in a given time period) that exceeds the capacity (the number of vehicles that can be processed in the same time period) of the entrance station. An automated lane is often viewed as a means of increasing capacity, and therefore reducing congestion, and is perceived as an attractive solution.

To determine whether this is true – that an automated lane can increase capacity – data was collected at Rocky Mountain National Park's Beaver Meadows entrance station on July 7, 8 and 10, 2006. Data on service times in the automated lane were collected in a manner similar to that used to collect service time data in manual (staffed) lanes at Arches and Grand Canyon National Parks and reported in "Service Times and Capacity at National Park Entrance Stations". The results from the Beaver Meadows automated lane were compared with data from the manual lanes at Arches and Grand Canyon.

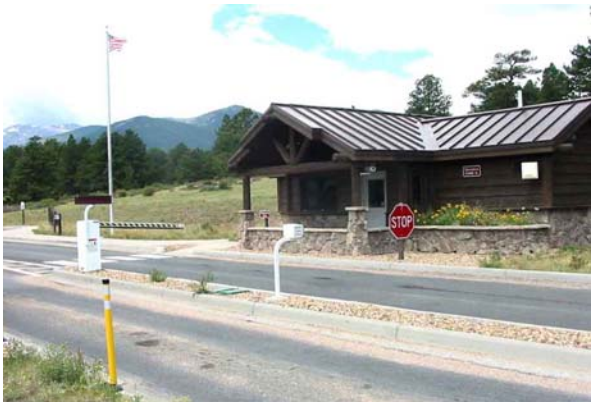
One of the advantages of collecting data at Beaver Meadows is that it is the only automated lane (among the five Parks with automated lanes) that uses both transponder and magnetic card reader technologies. Thus, data were collected on service times for both transponder transactions and magnetic card reader transactions. A further advantage of collecting data at Beaver Meadows is that it likely has many more automated transactions in a given time period than the other four

Parks (see Table B-1 for a comparison of the number of electronic tags or magnetic cards distributed), thus allowing collection of the needed quantities of data in a reasonable time period.

At Beaver Meadows the users of the magnetic card reader system must pull up to the card reader, stop, swipe their card, and proceed after the gate opens. For the transponder-based system, the antenna orientation and range is such that vehicles with electronic tags must come almost to a complete stop to allow the transponder to read the electronic tag and wait for the gate to open.



Automated Lane at Beaver Meadows



Automated Lane at Beaver Meadows

TERMINOLOGY

The terminology used in this study is the same as that used in the report on "Service Times and Capacity at National Park Entrance Stations". The definitions are repeated here for the convenience of the reader.

In the "Service Times and Capacity…" report, "service time" is defined as the length of time required for the Visitor Use Assistant (the National Park Service staff member at the entrance station) to process a customer at an entrance station. Service time begins when the vehicle comes to a stop at the entrance booth (arrival time). Service time ends when the vehicle begins to pull away from the entrance booth (departure time). Service time is measured in minutes and seconds. For an automated lane, there is no Visitor Use Assistant, but the concept is the same. Service time begins when the vehicle comes to a stop at the card reader (or an almost complete stop in the case of a vehicle with an electronic tag). Service time ends when the vehicle begins to pull away from the card reader (or begins to accelerate in the case of a vehicle with an electronic tag).

The definitions for the remaining terms are the same as in the "Service Times and Capacity…" report, as follows.

"Move-up time" occurs between the departure time of one vehicle and the arrival time of the following vehicle when there is a continuous supply of vehicles waiting to be served.

"Interval between arrivals", as used in this report, is the sum of service time and move-up time.

In the field of traffic engineering, “capacity” is defined as the maximum number of vehicles that can pass a given point on a roadway during a specified period under prevailing roadway, traffic and control conditions.

In this report, “capacity” for an entrance station is defined as the maximum number of vehicles per hour that can be processed in a lane (or lanes) at an entrance station. Capacity is expressed in vehicles per hour, but the rate can also apply to a shorter period of time. If capacity is 120 vehicles per hour, this means that 20 vehicles per ten minute period can be processed.

DATA COLLECTION

Data on service times and move-up times were collected at the Beaver Meadows Entrance Station automated lane on Friday, July 7, Saturday, July 8, and Monday, July 10, 2006. Data were collected over a total of almost 12 hours over the course of three days. The times of arrival and departure (hours:minutes:seconds) were recorded on a laptop computer in a spreadsheet. A macro feature was installed in the spreadsheet so that the arrival, and the departure, could each be entered with a single keystroke and the macro automatically inserted the current time. The type of transaction (card swipe or electronic tag) was also recorded. As each vehicle departed, a note was made on whether a succeeding vehicle was in queue to provide continuous supply of vehicles to process. If so, the time interval between the departing vehicle and the subsequent arriving vehicle provided data for move-up time. Over 370 usable transaction times for card swipe transactions were recorded, almost 90 usable transaction times for electronic tag transactions were recorded, and almost 120 move-up times were recorded.

OBSERVED OPERATION

Before presenting results for service times and move-up times, it is important to describe the observed operation of both electronic tag and card-swipe transactions. These observations will assist the reader in interpreting the results.

Electronic Tag Transactions

At Beaver Meadows, many of the vehicles with electronic tags had the tag affixed to the windshield, adjacent to the rear-view mirror. This location allowed the antenna to “read” the tag. For many of the vehicles, however, the driver or passenger was observed to hold the tag in their outstretched hand, toward the antenna, and “wave” the tag so that it would be detected by the antenna. These, presumably, were vehicles that had previously had trouble with the tag being read when it was affixed to the windshield. About one-third of electronic tag equipped vehicles were observed to wave the tag.

Some of the vehicles with electronic tags were unable to activate the system. In these instances, the driver had to contact the Visitor Use Assistant (VUA) in the kiosk in the adjacent lane, either by eye contact, verbally, or through an intercom adjacent to the card reader. The VUA then opened the gate manually. Twelve percent of the electronic tag equipped vehicles required this

intervention by a Visitor Use Assistant. Vehicles that required VUA intervention had longer service times than those that did not.

In the opinion of the author, the above problems are fixable technological problems. The fixes include replacement of electronic tags, improved tuning of the antenna system, and the use of a performance specification for equipment acquisition. Customer acceptance of the system, or payment, can be contingent upon acceptable performance following equipment installation.

Card-Swipe Transactions

A variety of users engage in card-swipe transactions. Some employees have an employee card that can be used in the card reader. There are a very large number of Rocky Mountain National Park annual pass passholders and large numbers of National Parks Passes and Golden Age Passports that have been encoded for use in the automated lane (see Table B-1).

Observation of card-swipe transactions demonstrated that there are frequent users who are well-practiced in the use of the card. These users position their vehicle correctly to be able to reach the card reader, have learned the proper orientation of the card for swiping, and have learned the proper speed to swipe the card (not too fast or too slow).

Learning the proper card orientation is very important. There are at least four possible orientations of the card, and only one of these orientations will allow the card to be read. When a Rocky Mountain annual pass is purchased, the cardholder is given printed instructions, including proper orientation. Written instructions for card orientation are also printed on the card reader. Many passholders were observed to need to swipe the card two, three, four, five, or more times to successfully open the gate.

Observation of card-swipe transactions also demonstrated that there are infrequent users whose transactions are much less efficient than well-practiced users. These users may have to back up and reposition their vehicle to be able to reach the card reader, may have to open the car door and/or unbuckle the seatbelt to reach the card reader, and may have to swipe the card many times because they have not learned the proper card orientation.

Service times for frequent users are short, while service times for infrequent users can be much longer.

On a significant number of occasions, a card-swipe transaction may fail. A card may have expired. The magnetic encoding on the card may have decayed and may no longer be readable (this occurs with conventional credit cards and may simply be the result of two credit cards being stored in the wallet with magnetic strips adjacent to one another). A user may be using a card that is not eligible, for whatever reason, for use in the automated lane.

At the time of the data collection, Rocky Mountain National Park had chosen to use no advance signing to mark the automated lane and to indicate who are the eligible users. Because of the wide variety of eligible users and because some National Park Passes and Golden Age Passports are eligible (those purchased at Rocky Mountain National Park, as well as those purchased

elsewhere and subsequently encoded at Rocky Mountain National Park) and some are not, it would be very difficult to present a clear and simple sign message on who may use the lane.

Because there is no signing, some visitors do not realize it is an automated lane until they are "trapped" in the lane. This is more likely to happen when there is a queue, especially if the vehicles in front of the visitor are large and obscure the view of the card reader and gate arm. Other visitors, for whatever reason, believe they have an eligible card, but do not. When those visitors attempt to use the card reader, they find that their card will not work.

The above situations generally lead to one of three responses. First, as in failed electronic tag transactions, it may lead to intervention by a VUA in the adjacent lane who will manually open the gate. Second, it may result in a VUA or supervisor walking from the office to the card reader and there assisting the visitor in swiping the card or requesting that the gate be opened manually. Third, the vehicle may abort by backing up and moving to the adjacent regular lane. This maneuver is difficult if there are other vehicles in queue in the automated lane.

During the data collection period, five percent of the attempted card-swipe transactions led to abort maneuvers. In addition, at least 13 card-swipe transactions had service times of 60 seconds or longer. Many of these transactions ultimately led to manual opening of the gate arm by a VUA. Some led to abort maneuvers. Others were simply the result of many, many card swipe attempts that were ultimately successful. The longest recorded service time was 2 minutes, 10 seconds.

Some of the above challenges to efficient card-swipe transactions can be addressed, while others are more difficult because they represent human factors issues.

The most important general observation is that card-swipe transactions can be efficient if distribution is restricted to groups of frequent users such as employees and Park residents. As more and more classes of users become eligible, they tend to be those who use the system less frequently. These users have less efficient and more time-consuming transactions.

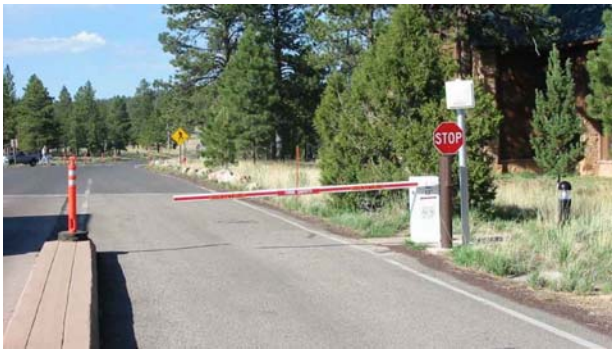
MOVE-UP TIMES AND INTERVAL BETWEEN ARRIVALS

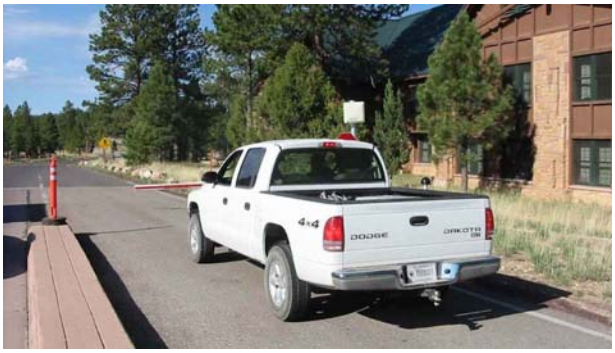
With the above observations in mind, the reader can now better interpret the results for service times and move-up times.

The average move-up time in the Beaver Meadows automated lane was 6 seconds. This is essentially the same as the observed move-up times for manual lanes at Arches National Park (7 seconds) and Grand Canyon National Park (also 7 seconds).

Two values are presented here for the interval between arrivals for electronic tag transactions. Keep in mind that interval between arrivals includes both the service time and the move-up time. When transactions are included that required the gate arm to be opened manually by the VUA, the average interval between arrivals was 12 seconds. When transactions requiring manual gate opening are excluded, the average interval between arrivals was 10 seconds.

Similarly, two values are presented for card-swipe transactions. The larger value (20 seconds) includes transactions that required the gate arm to be opened manually or involved abort maneuvers. The smaller value (15 seconds) does not include these situations.





Automated Lane at Bryce Canyon National Park using Transponder / Electronic Tag Technology

COMPARISON OF AUTOMATED LANES AND MANUAL LANES

The key objective in this study was to determine whether an automated lane can increase capacity. This section helps to answer that question by comparing the total time required to process a vehicle (the interval between arrivals) in an automated lane versus a manual (staffed) lane. Data from the Beaver Meadows automated lane is compared with manual lanes at Arches and Grand Canyon National Parks.

This comparison is made by looking at selected classes of users for manual lanes and making the comparison to an automated lane.

Electronic Tags for Frequent Users

Because of the cost of an electronic tag, electronic tag technology would be impractical for visitor use, but would be practical for frequent users such as employees and Park residents. Electronic tag transaction times were also observed to be shorter than card-swipe transaction times. For these reasons, it makes sense to compare the interval between arrivals for electronic tags with the interval between arrivals in manual lanes for frequent users at Arches and Grand Canyon.

At Arches National Park, the transaction type of "Non-Recreation" is entry of Park employee, vendor, construction personnel, or other individuals to whom an entry fee does not apply. The interval between arrivals for this transaction type is 14 seconds.

At Grand Canyon National Park, the transaction type of "Re-Entry Local" is entry by a Park resident or by native American who lives on lands adjacent to the Park and the transaction type of "Re-Entry Business" is entry by a commercial business with an establishment within the Park,

vendors serving the Park, UPS, etc. The interval between arrivals for both of these transaction types is 10 seconds.

As shown in Table B-2, manual operation at the Grand Canyon is as quick as automated operation (electronic tag) and manual operation at Arches National Park is almost as quick as automated operation (electronic tag). In terms of processing time, automated operation with an electronic tag offers little to no advantage over manual operation.

TABLE B-2 - ELECTRONIC TAGS FOR FREQUENT USERS

	Interval Between Arrivals	
	Manual	Automated
Arches National Park -- Non-Recreation	14 seconds	
Grand Canyon National Park -- Re-Entry Local	10 seconds	
Grand Canyon National Park -- Re-Entry Business	10 seconds	
Beaver Meadows -- Electronic Tag		10 / 12 seconds *
* the value of 12 seconds includes transactions that required manual opening of the gate		

Card-swipe Technology for Frequent Users

These same transaction types at Arches and Grand Canyon can also be compared to card-swipe transactions in an automated lane.

As shown in Table B-3, manual operation at the Grand Canyon and Arches are both faster than automated operation (card-swipe). In terms of processing time, automated operation with a card swipe is a disadvantage compared to manual operation.

TABLE B-3 - CARD-SWIPE TECHNOLOGY FOR FREQUENT USERS

	Interval Between Arrivals	
	Manual	Automated
Arches National Park -- Non-Recreation	14 seconds	
Grand Canyon National Park -- Re-Entry Local	10 seconds	
Grand Canyon National Park -- Re-Entry Business	10 seconds	
Beaver Meadows -- Card-Swipe		15 / 20 seconds *
* the value of 20 seconds includes transactions that required manual opening of the gate or an abort maneuver		

Card-swipe Technology for Re-entry on 7-Day Permits

Many Parks have a significant proportion of entering vehicles that are re-entering on a previously purchased 7-day permit. At Arches National Park, this transaction type is referred to as "Entrance Auto" and accounts for about 10 percent of all transactions. At Grand Canyon National Park, this transaction type is called "Re-Entry Single Visit" and accounts for about 14 percent of all transactions.

Because of the significant proportion of entries, this type of transaction could be considered for automated processing. At Arches National Park, the interval between arrivals for this transaction type is 13 seconds and at Grand Canyon National Park it is 15 seconds (manual operation). Table B-4 compares these times with card-swipe times at Beaver Meadows.

As shown in Table B-4, manual operation at the Grand Canyon and Arches are both faster than automated operation (card-swipe). If one assumes that a card-swipe type of system were created for 7-day permits, it would operate at a disadvantage, in terms of processing time, compared to manual operation.

TABLE B-4 - CARD-SWIPE TECHNOLOGY FOR RE-ENTRY ON 7-DAY PERMITS

	Interval Between Arrivals	
	Manual	Automated
Arches National Park -- Entrance Auto	13 seconds	
Grand Canyon National Park -- Re-Entry Single Visit	15 seconds	
Beaver Meadows -- Card-Swipe		15 / 20 seconds *
* the value of 20 seconds includes transactions that required manual opening of the gate or an abort maneuver		

Card-swipe Technology for Passholders

Rocky Mountain National Park uses its automated lane, in the card-swipe mode, to allow access by holders of the Rocky Mountain National Park annual pass, the National Park Pass, and Golden Age Passports. As a final comparison, it is of interest to compare manual versus automated operation for these classes of users.

As shown in Table B-5, a card-swipe system does offer faster processing. The magnitude of this advantage is open to some interpretation. If the 20 second value for the card-swipe is used, for example, it offers a very modest advantage over the manual times observed at Arches National Park. The advantage over manual times at the Grand Canyon is larger. However, for both Parks, it should be pointed out that the times for manual processing include a photo I.D. check to ensure

TABLE B-5 - CARD-SWIPE TECHNOLOGY FOR PASSHOLDERS

	Interval Between Arrivals	
	Manual	Automated
Arches National Park -- National Parks Pass	23 seconds	
Arches National Park -- Golden Age Passport	25 seconds	
Arches National Park -- Golden Access Passport	22 seconds	
Grand Canyon National Park -- National Parks Pass	31 seconds	
Grand Canyon National Park -- Golden Age Passport	33 seconds	
Grand Canyon National Park -- Golden Access Passport	41 seconds	
Beaver Meadows -- Card-Swipe		15 / 20 seconds *
* the value of 20 seconds includes transactions that required manual opening of the gate or an abort maneuver		

that the individual presenting the pass is indeed the owner named on the pass. The photo I.D. check reduces fraudulent use of the card. An automated lane does not provide the opportunity to reduce fraudulent use.

No data was collected for proximity card systems (the type of technology contemplated for the West Yellowstone Entrance Station). Proximity card systems may have slightly shorter service times than magnetic card reader technology, because precise placement and orientation of the card is not required.

ADDITIONAL CAPACITY CONSIDERATIONS

While an automated lane can reduce transaction times (compared to manual operation) for at least some types of transactions under certain conditions, this does **not** mean that an automated lane will increase capacity of an entrance station as a whole.

Whether an automated lane will increase capacity of an entrance station as a whole is dependent upon a complex interaction of the proportion of transaction types, the number of users who choose to enable their passes for automated use, and whether an automated lane is created by converting an existing lane to automated use versus constructing an additional lane that will be automated.

If a Park is considering an entrance station improvement, the following is recommended as a logical approach for decision-making.

1. Make a decision on whether an additional lane will be added. This decision is independent of whether the additional lane will be a manually operated lane or an automated lane. Due to natural or cultural resource issues, topography, financial constraints, or other issues, adding a lane may be impractical.

2. If a decision is made to add a lane, then a decision can be made on whether it will be manual or automated. This decision would consider the effect on overall entrance station capacity and / or the ability to provide expedited entry to certain classes of users, and perhaps other factors.

3. If a decision is made to not add a lane, then a decision can be made on whether to convert an existing manual lane to an automated lane. In this situation, it will be very important to carefully assess the effect on overall entrance station capacity. It is unlikely that a Park will have a set of conditions under which converting a lane from manual operation to automated operation will increase overall entrance station capacity.

This report demonstrates that, for at least some types of transactions, an automated lane results in faster processing time. The report has also stated that introduction of an automated lane may actually reduce overall entrance station capacity. At first glace this appears to be a contradiction but it can best be explained by an example.

Let's assume that a Park has an existing four-lane entrance station with all lanes operating manually. For this particular Park, let's also assume that the mix of transaction types and transaction times results in a capacity of 100 vehicles per hour per lane. Based on data collected at Arches and Grand Canyon, this is a realistic number. The capacity of the entrance station as a whole is therefore 400 vehicles per hour.

The Park decides to convert one of the existing lanes to an automated lane. The type of technology does not make much difference for this example, but let's say that the Park chooses electronic tag technology. The Park also decides that all Park residents and employees will receive an electronic tag and be eligible to use the automated lane. No other users will be eligible. Residents and employees account for 14 percent of all vehicles processed at the entrance station. If the demand is 400 vehicles per hour, this means that (0.14 x 400), or 56 vehicles per hour are eligible to use the automated lane. The automated lane can easily handle 56 vehicles per hour because the average time required for each vehicle is only 10 to 12 seconds.

Because only 56 vehicles per hour are eligible to use the automated lane, the throughout, or number of vehicles per hour processed by that lane is 56. How many vehicles per hour will each of the other three (manual) lanes process? It will not be 100 vehicles per hour because the mix of transactions in those lanes has changed. Those lanes no longer process Park residents and employees – transactions that were relatively fast under manual control. As a result, the average time in the regular lanes has increased and the capacity has decreased. Perhaps the capacity in each of those lanes has dropped to 95 vehicles per hour. The total throughput of the entrance station is now only 56 + 95 + 95 + 95, or 341 vehicles per hour. In a sense, the automated lane is "stealing" capacity that would otherwise be available. The automated lane is underutilized because there are not enough eligible vehicles to provide it a continuous supply of vehicles.

This is a simple example, but it makes the point that "capacity" of an entrance station may actually be reduced with the introduction of an automated lane. It also demonstrates that, to justify an automated lane when entrance station capacity is an issue, a Park must have a very high proportion of its customers who are eligible to use an automated lane. [Note: This point emphasizes the fact that automated lanes would become much more practical if all National Park Passes sold throughout the country were sold with a magnetically encoded expiration date. Similarly, if the America the Beautiful Pass is implemented with this feature, automated lanes would become much more practical.]

A second example, similar to the one above, could be presented if the Park chose to add a fifth lane (an automated lane) to the existing four lane entrance station. The capacity of the five lane entrance station would be greater than the previous four lane entrance station. However, like the example above, the more important question to ask is whether a five lane entrance station with one automated lane would have more capacity than a five lane entrance station with five manual lanes. The answer to this question is almost certainly, "No". If there is still a capacity problem with an expansion to five lanes, the Park would be better off with the fifth lane as a manual lane rather than an automated lane.

In the context of the above examples, it is worth noting that the automated lane at Rocky Mountain's Beaver Meadows entrance station was added as a fourth entrance lane at an existing three lane entrance. Rocky Mountain National Park is close to a major urban area of over two million population. The Park has many repeat visitors and sells a large number of Rocky Mountain National Park annual passes. This produces a relatively high proportion of customers who are eligible to use an automated lane. In summer, about one-fourth to one-third of all entrants use the automated lane. This is an example of a set of circumstances that was somewhat favorable to the addition of an automated lane.

Additional Planning and Design Decisions

Clearly, an important decision in the planning and design process is to determine what classes of users will use the automated lane. Coupled with this decision is the question of what technology should be used (electronic tag, card-swipe, or other). If card-swipe technology is selected, a companion question is whether the Park wants to invest the staff time to magnetically encode every card and pass that is sold on-site. These are all questions that a Park must answer in the planning and design of an automated lane.

ACCESSABILITY TO AUTOMATED LANE

As noted earlier, a Park's interest in an automated lane may be partly motivated by a desire to provide expedited entry to certain classes of users. These may be frequent users such as Park employees, Park residents, Park Service vehicles, concessionaire vehicles, etc. This motivation may be especially strong when the waiting times would otherwise be inconveniently long.

In these instances, access to the automated lane may become a critical issue. At many Park entrance stations the approach roadway is a single lane road until it is within a few hundred feet of the entrance station. It is only at that point that the approach widens to multiple lanes. If there are long queues backed up from the manual lanes, those vehicles may "choke off" access to the automated lane, thus partially defeating the goal of expedited entry. This may also have the effect of reducing the throughput of the automated lane.

Park's that are planning an automated lane must carefully design the entrance station approach to minimize this type of problem.

COST

At Rocky Mountain's Beaver Meadows entrance station, the cost of the automated lane (both the electronic tag system and the card-swipe system) was about $80,000 to $90,000, plus the cost of constructing an additional lane.

ADVANTAGES AND DISADVANTAGES OF AUTOMATED LANES

Automated lanes have many advantages and disadvantages that a Park should consider in entrance station planning and design. Table B-6 summarizes these advantages and disadvantages.

TABLE B-6 - ADVANTAGES AND DISADVANTAGES OF AUTOMATED LANES

ADVANTAGES	DISADVANTAGES
May increase the capacity of an entrance station. A careful analysis is required to determine if capacity will be increased.	May decrease the capacity of an entrance station. This is especially likely if a small percentage of all entrance station traffic would be eligible for automated lane.
May reduce congestion and waiting times.	May exacerbate congestion and waiting times if capacity decreases.
	A separate lane must be set aside for automated entry
Can function efficiently when technology works properly and users are well-practiced	Efficiency is affected by technology failures and users who infrequently use the system
May provide expedited entry to certain classes of users by allowed qualified users to "jump" the queue.	Expedited entry may be limited if approach does not provide unencumbered access. Queues from other lanes may restrict access.
May reduce manpower and staffing requirements and reduce personnel costs.	An automated lane is unlikely to function without staff intervention to assist the customer from time to time.
	Staffing is required for administration and backoffice operation. Eligibility of users must be verified. Electronic tags must be issued and recovered. Magnetic cards must be encoded - a time consuming operation.
	Signing to indicate eligible users of automated lane must be provided.
	Requires Park staff expertise for design, specifications, and maintenance.
	Potential for fraudulent use of a card by other than the original cardholder. Unlike a photo ID check in a staffed lane, a confirmation is not be possible with an automated system.

RECOMMENDATION

Any Park that is considering an automated lane should gain a full understanding of the advantages and disadvantages of automated lane operation. This report provides much useful background. In addition, any Park that is considering an automated lane should seek out the experience of other Parks that have implemented automated lanes. Contact persons for Assateague Island National Seashore, and Bryce Canyon, Rocky Mountain, Yellowstone and Zion National Parks are listed in Table B-1. In addition, the author would be pleased to assist any Park in evaluating the appropriateness of an automated lane.

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